

## Complicated Hypertension: Review Questions

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### QUESTIONS

Choose the single best answer for each question.

1. A 28-year-old obese woman presents to her doctor's office with persistent headache and malaise. She is otherwise healthy. Blood pressure measured in the office is 190/110 mm Hg. Serum electrolytes demonstrate hypokalemia (serum potassium, 3.0 mEq/L) and metabolic alkalosis (serum bicarbonate, 32 mEq/L) with normal kidney function. Urinalysis reveals no proteinuria, cylinduria, or casts. A secondary cause of hypertension is considered. Renal ultrasound shows normal echogenicity, with the right kidney 12.0 cm and the left kidney 10.5 cm in length. Doppler examination is technically limited by her obesity. A renal angiogram reveals significant stenosis (90%) of the left renal artery due to fibromuscular dysplasia. What is the best management option for this patient at this point?

  - (A) Perform renal artery bypass
  - (B) Serial ultrasonography to assess kidney size
  - (C) Perform percutaneous angioplasty of the stenotic lesion
  - (D) Start an angiotensin-converting enzyme (ACE) inhibitor and titrate to control blood pressure
2. A 76-year-old man with a past history of non-insulin-dependent diabetes mellitus and hypertension is seen in the office. His blood pressure is 140/85 mm Hg, and he has mild renal insufficiency (serum creatinine, 1.4 mg/dL). Urinalysis reveals 2+ protein on dipstick but no cylinduria. Blood pressure medications include hydrochlorothiazide and atenolol. What antihypertensive agent will best control blood pressure and preserve renal function in this patient?

  - (A) Amlodipine
  - (B) Furosemide
  - (C) Lisinopril
  - (D) Verapamil
3. A 4-year-old girl is brought to her pediatrician's office with lower extremity weakness and inability to walk. She is afebrile, but her blood pressure is 130/80 mm Hg. Routine serum chemistries show profound hypokalemia and metabolic alkalosis. Hypokalemia is the suspected cause of her lower extremity weakness. Further history reveals that the child ate an entire candy dish of authentic black licorice at her grandmother's house. What hormone caused the syndrome with which this child presents?

  - (A) Aldosterone
  - (B) Cortisol
  - (C) Dihydrotestosterone
  - (D) Progesterone
4. A 35-year-old healthy man is referred for hypertension. His blood pressure is 190/105 mm Hg and laboratory tests show hypokalemia (serum potassium, 2.1 mEq/L) and metabolic alkalosis (serum bicarbonate, 36 mEq/L) with normal renal function. Given his age, there is concern for secondary causes of hypertension. The plasma renin activity (PRA) level is low (0.5 ng/mL per hour), the plasma aldosterone concentration (PAC) is high (22.5 ng/dL), and the PAC:PRA ratio is 45. After 3 days of oral salt loading, the patient collects a 24-hour urine sample that reveals an elevated aldosterone concentration (> 14 µg/day). What is the next step in the workup of this patient's hypertension?

  - (A) Bilateral renal vein sampling
  - (B) Captopril renal scan
  - (C) Computed tomography (CT) scan of the abdomen
  - (D) Renal artery angiogram

*(turn page for answers)*

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## ANSWERS AND EXPLANATIONS

- 1. (C) Perform percutaneous angioplasty of the stenotic lesion.** Fibromuscular dysplasia is a disease of predominantly young women. It presents with severe hypertension, often accompanied by hypokalemia and metabolic alkalosis. These metabolic disturbances are due to secondary hyperaldosteronism. The treatment of choice is percutaneous balloon angioplasty, which often is curative. In contrast, atherosclerotic renal artery disease is frequently resistant to balloon angioplasty alone and requires either stent placement or renal artery bypass surgery. ACE inhibitors would control blood pressure; however, the stenotic kidney would develop ischemia and lose function. Serial ultrasonography of the kidney, to document ischemic renal atrophy, would not be appropriate as the patient already qualifies for intervention based on the high-grade lesion. Renal artery bypass would only be indicated if balloon angioplasty failed.
- 2. (C) Lisinopril.** This patient has diabetic nephropathy and hypertension. His blood pressure has not yet achieved the recommended blood pressure target (125/75 mm Hg). Diabetic nephropathy typically follows an inexorable course of progression to end-stage renal disease. As shown in multiple studies, ACE inhibitors are the best class of agents to control blood pressure, reduce proteinuria, and slow progression of diabetic kidney. Following initiation of lisinopril, serum potassium and renal function should be monitored to identify the development of either hyperkalemia or acute renal failure. A 30% reduction in glomerular filtration rate is acceptable as long as renal function stabilizes at the new level within the next 60 days. Proteinuria should be reassessed intermittently to document efficacy and allow titration of the ACE inhibitor. An optimal level of proteinuria is less than 1 g/day and is associated with renoprotection. The other agents listed may control blood pressure but do not have the same renoprotective effect of lisinopril; in fact, some of these agents may worsen proteinuria.
- 3. (B) Cortisol.** Excessive consumption of licorice causes the syndrome of apparent mineralocorticoid excess. It manifests as hypertension, hypokalemia, and metabolic alkalosis. Licorice contains glycyrrhetic

acid, a substance that inhibits 11 $\beta$ -hydroxysteroid dehydrogenase. This enzyme normally functions to convert cortisol to cortisone. This is important because cortisol avidly binds the mineralocorticoid receptor in the collecting tubules of the kidney, mimicking aldosterone's effects (ie, salt retention, potassium excretion). Cortisone is unable to bind the receptor. In patients in whom this enzyme is inhibited, cortisol is not converted to cortisone, inducing a syndrome that presents similarly to mineralocorticoid excess. Aldosterone levels in this situation are suppressed and therefore do not cause hypertension. Dihydrotestosterone and progesterone are not metabolized by 11 $\beta$ -hydroxysteroid dehydrogenase and have no effect on the mineralocorticoid receptor.

- 4. (C) CT scan of the abdomen.** The clinical presentation of this patient, along with the laboratory findings of suppressed PRA, elevated PAC, a high PAC:PRA ratio, and increased urinary aldosterone excretion, is diagnostic of primary hyperaldosteronism. The next step in his workup should be a CT scan of the abdomen to evaluate for the presence of an adrenal macroadenoma, unilateral or bilateral adrenal hyperplasia, or an adrenal carcinoma. This patient had a 2.2-cm unilateral adrenal adenoma. The treatment of choice in a young man with this lesion is surgical resection, which is often curative. Bilateral renal vein sampling is indicated following a CT scan in the following circumstances: (1) to exclude a nonfunctioning cortical adenoma in the patient who is older than 40 years, and (2) to assess for aldosterone lateralization in patients with normal-appearing adrenal glands, micronodular adrenal glands, or bilateral adrenal masses/hyperplasia. With a suppressed PRA, there is no evidence to support renovascular hypertension. Therefore, neither a renal angiogram nor a captopril renal scan is warranted.

## SUGGESTED READINGS

- Brewster UC, Setaro JF, Perazella MA. The renin-angiotensin-aldosterone system: cardiorenal effects and implications of renal and cardiovascular disease states. *Am J Med Sci* 2003;326:15–24.
- Cruz DN, Perazella MA. Hypertension and hypokalemia: unusual syndromes. *Connecticut Med* 1997;61:67–75.

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